CLAIM + DETAILED DESCRIPTION

[Claim(s)]

[Claim 1] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which **** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell. A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on a resistance detection means to detect resistance of said fuel cell of current ******, and the current detected by said current detection means and the resistance detected by said resistance detection means.

[Claim 2] Said humidification state judging means is a fuel cell system according to claim 1 which is a means to judge the humidification state of said electrolyte membrane based on time change of the value of the resistance detected by said resistance detection means in case the value of the current detected by said current detection means is a predetermined value.

[Claim 3] Said humidification state judging means is a fuel cell system according to claim 2 which is a means to judge that is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.

[Claim 4]It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which **** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell. A voltage detection means to detect the voltage outputted from said fuel cell, and an amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on the current detected by said current detection means when the amount of supply of said fuel is changed by this amount change means of fueling, and the voltage detected by said voltage detection means.

[Claim 5] [said humidification state judging means] When the amount of supply of said fuel is increased by said amount change means of fueling The fuel cell system according to claim 4 which is a means to judge the humidification state of said electrolyte membrane based on time change of the value of the voltage detected by said voltage detection means in case the value of the current which came out, exists and was detected by said current detection means is a predetermined value.

[Claim 6] Said humidification state judging means is a fuel cell system according to claim 5

which is a means to judge that is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.

[Claim 7] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which **** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A humidification means to humidify said fuel supplied to said fuel cell, and a voltage detection means to detect the voltage outputted from said fuel cell, An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell, A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on the voltage detected by said voltage detection means before and after changing the amount of supply of fuel by this amount change means of fueling.

[Claim 8] [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] The fuel cell system according to claim 7 which is a means to judge with humidification being insufficient when the detected voltage is larger than the voltage detected by this voltage detection means after the amount of supply of fuel is increased by this amount change means of fueling.

[Claim 9] It is the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which **** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A voltage detection means to detect the voltage of each battery module which serves as a humidification means to humidify said fuel supplied to said fuel cell from each single battery or the single battery of the same number which constitutes said fuel cell. An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell, A fuel cell system equipped with a humidification state judging means to judge the humidification state of said electrolyte membrane based on the variation in the voltage of each single battery detected by said voltage detection means before and after changing the amount of supply of fuel by this amount change means of fueling, or each battery module.

[Claim 10] [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] The variation in the voltage of each detected single battery or each battery module [with this amount change means of fueling] The fuel cell system according to claim 9 which is a means to judge with humidification being superfluous when larger than the variation in the voltage of each single battery detected by this voltage detection means, or each battery module after the

amount of supply of fuel is increased.
[Claim 11] There is no Claim 1 equipped with a humidification control means to control humidification of said fuel by said humidification means based on the judgment by said humidification state judging means, and it is the fuel cell system of a description 10 either.
[Claim 12] Said humidification control means is a fuel cell system according to claim 11 which is a means to increase the amount of humidification of said fuel by said humidification means when judged with humidification being insufficient by said humidification state judging means.
[Claim 13] Said humidification control means is a fuel cell system according to claim 11 which is a means to increase the pressure of said fuel supplied to said fuel cell by said fueling means when judged with humidification being insufficient by said humidification state judging means.
[Claim 14] Have a working temperature control means to be a fuel cell system according to claim 11, and to control the working temperature of said fuel cell, and [said humidification control means] The fuel cell system which is a means to reduce the working temperature of said fuel cell by said working temperature control means when judged with humidification being insufficient by said humidification state judging means.
[Claim 15] Said humidification control means is a fuel cell system according to claim 11 which is a means to reduce the amount of supply of said fuel to said fuel cell by said fueling means when judged with humidification being insufficient by said humidification state judging means.
[Claim 16] Said humidification control means is a fuel cell system according to claim 11 which is a means to reduce the amount of humidification of said fuel by said humidification means when judged with humidification being superfluous by said humidification state judging means.
[Claim 17] Said humidification control means is a fuel cell system according to claim 11 which is a means to reduce the pressure of said fuel supplied to said fuel cell by said fueling means when judged with humidification being superfluous by said humidification state judging means.
[Claim 18] Have a working temperature control means to be a fuel cell system according to claim 11, and to control the working temperature of said fuel cell, and [said humidification control means] The fuel cell system which is a means to raise the working temperature of said fuel cell by said working temperature control means when judged with humidification being superfluous by said humidification state judging means.
[Claim 19] Said humidification control means is a fuel cell system according to claim 11 which is a means to increase the amount of supply of said fuel to said fuel cell by said fueling means when judged with humidification being superfluous by said humidification state judging means.
[Claim 20] There is no Claim 11 equipped with a malfunction detection means to detect the malfunction of said fuel cell system when it is judged with the shortage of humidification or humidification being superfluous by said humidification state judging means, in spite of having performed humidification control of said fuel by said humidification control means predetermined time, and it is the fuel cell system of a description 19 either.

[Claim 21] The fuel cell system according to claim 20 equipped with an unusual output means to output these abnormalities when said malfunction detection means detects abnormalities.
[Claim 22] The fuel cell system according to claim 20 or 21 equipped with an operation stop means at the time of the abnormalities which stop operation of said fuel cell system when said malfunction detection means detects abnormalities.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which ... an electrolyte membrane and this electrolyte membrane in detail about a fuel cell system.
[0002]
[Description of the Prior Art] What [judges shortage of the amount of moisture conventionally contained in an electrolyte membrane as this kind of a fuel cell system based on the temperature of a solid polymer type fuel cell and the voltage outputted from a fuel cell], What judges shortage of the amount of moisture contained in an electrolyte membrane based on the temperature of a fuel cell, the current threshold from which the amount of change of the voltage outputted from a fuel cell is drawn as a parameter, and the current outputted from a fuel cell is proposed (for example, JP,H7-272738,A etc.). The permission minimum voltage which corresponds from the reaction temperature of the fuel cell detected in this system using the table of the relation between the reaction temperature of a fuel cell and the permission minimum voltage of the voltage outputted from a fuel cell is drawn. As compared with the voltage outputted from a fuel cell by making this into a threshold, when voltage is smaller than a threshold, it has judged with the amounts of moisture contained in an electrolyte membrane being insufficient. Moreover, in this system, the maximum permissible current value is drawn as a threshold by making into a parameter the amount of change of the temperature of a fuel cell, and the voltage outputted from a fuel cell. This threshold is compared with the current outputted from a fuel cell, and when current is larger than a threshold, it was judged with the amounts of moisture contained in an electrolyte membrane being insufficient. And in this system, when judged with the amounts of moisture contained in an electrolyte membrane being insufficient, the current supplied to load is restricted.
[0003]
[Problem to be solved by the invention] However, in an above-mentioned fuel cell system, since the amount of moisture of the electrolyte membrane was greatly influenced by the temperature of a fuel cell, the pressure of fuel gas, the amount of supply of fuel gas, etc., there was a problem that the accuracy of a judgment of the amount of moisture of an electrolyte

membrane became low. Moreover, in the above-mentioned fuel cell system, when judged with the amounts of moisture of an electrolyte membrane being insufficient, the current supplied to load was restricted, and the electrolyte membrane was protected from the breakage, but there was also a problem that the amount of moisture of an electrolyte membrane could not be made into the suitable range.

[0004] The fuel cell system of this invention is taken as one thing of the purpose for which the humidification state of an electrolyte membrane is judged more correctly. Moreover, the fuel cell system of this invention is taken as one thing of the purpose adjusted so that the humidification state of an electrolyte membrane may become a proper range. Furthermore when the humidification state of an electrolyte membrane cannot be adjusted the fuel cell system of this invention in the proper range, while judging as unusual, when the abnormality is judged, it is taken also as one thing of the purpose for which an electrolyte membrane is protected from that breakage.

[0005]

[The means for solving a technical problem, and its operation and effect] The fuel cell system of this invention took the following means, in order to attain a part of above-mentioned purpose. [at least].

[0006] The 1st fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which [illegible] an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas like fuel to said fuel cell, a humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on a resistance detection means to detect resistance of said fuel cell of current [illegible], and the current detected by said current detection means and the resistance detected by said resistance detection means.

[0007] In the 1st fuel cell system of the this invention, a humidification state judging means judges the humidification state of an electrolyte membrane based on the current outputted from the fuel cell detected by a current detection means, and resistance of the fuel cell of current [illegible] detected by a resistance detection means. This judgment is based on resistance of a fuel cell changing with the humidification states of an electrolyte membrane a lot. In addition, what is supplied to either of two electrodes which pinch an electrolyte membrane, and the thing supplied to the both sides of two electrodes are also contained in fuel. The meaning of this fuel is the same also in the 2nd or the 4th fuel cell system of the following this invention.

[0008] According to the 1st fuel cell system of such this invention, since it judges based on

resistance of the fuel cell which becomes settled directly according to the humidification state of current and an electrolyte membrane outputted from a fuel cell, the humidification state of an electrolyte membrane can be judged more correctly.

[0009] In the 1st fuel cell system of this the invention, [said humidification state judging means] It shall be a means to judge the humidification state of said electrolyte membrane based on time change of the value of the resistance detected by said resistance detection means in case the value of the current detected by said current detection means is a predetermined value. If it carries out like this, since it will be judged based on the value of resistance of a fuel cell when [illegible]ing the same current, the humidification state of an electrolyte membrane can be judged more correctly. In the 1st fuel cell system of this invention of this mode, said humidification state judging means shall be a means to judge that is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.

[0010] The 2nd fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which [illegible] an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell, A humidification means to humidify said fuel supplied to said fuel cell, and a current detection means to detect the current outputted from said fuel cell, A voltage detection means to detect the voltage outputted from said fuel cell, and an amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell, Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on the current detected by said current detection means when the amount of supply of said fuel is changed by this amount change means of fueling, and the voltage detected by said voltage detection means.

[0011] In the 2nd fuel cell system of this this invention, [a humidification state judging means] The humidification state of an electrolyte membrane is judged based on the current outputted from the fuel cell detected by a current detection means when the amount of supply of the fuel to a fuel cell is changed by the amount change means of fueling, and the voltage outputted from the fuel cell detected by a voltage detection means. This judgment is based on change of the amount of supply of the fuel to a fuel cell affecting the humidification state of an electrolyte membrane.

[0012] According to the fuel cell system of such this invention, since it judges based on the amount of supply, current, and voltage of fuel to a fuel cell which are the factor which affects the humidification state of an electrolyte membrane, the humidification state of an electrolyte membrane can be judged more correctly.

[0013] In the 2nd fuel cell system of this this invention, [said humidification state judging means] When the amount of supply of said fuel is increased by said amount change means of fueling it shall be a means to judge the humidification state of said electrolyte membrane based on time change of the value of the voltage detected by said voltage detection means in case the value of the current which came out, exists and was detected by said current detection means is a predetermined value. If it carries out like this, since it is judged based on time change of the voltage at the time of the same current the humidification state of an electrolyte membrane can be judged more correctly. In the 2nd fuel cell system of this invention of this mode, said humidification state judging means shall be a means to judge that is [humidification of said electrolyte] insufficient when said time change exceeds the predetermined range, and to judge with humidification of said electrolyte being superfluous when said time change is less than said predetermined range.

[0014] The 3rd fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which [ ] an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of the fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell, A humidification means to humidify said fuel supplied to said fuel cell, and a voltage detection means to detect the voltage outputted from said fuel cell, an amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on the voltage detected by said voltage detection means before and after changing the amount of supply of fuel by this amount change means of fueling.

[0015] In the 3rd fuel cell system of this this invention, a humidification state judging means judges the humidification state of an electrolyte membrane based on the voltage outputted from the fuel cell detected by a voltage detection means before and after changing the amount of supply of the fuel to a fuel cell by the amount change means of fueling. This judgment is based on change of the amount of supply of the fuel to a fuel cell affecting the humidification state of an electrolyte membrane.

[0016] According to the 3rd fuel cell system of such this invention, since it judges based on the amount of supply and voltage of fuel to a fuel cell which are the factor which affects the humidification state of an electrolyte membrane, the humidification state of an electrolyte membrane can be judged more correctly.

[0017] In the 3rd fuel cell system of this this invention, [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] When the detected voltage is larger than the voltage detected by this voltage detection means after the amount of supply of fuel is increased by this amount change means of fueling, it shall be a means to judge with

humidification being insufficient.

[0018] The 4th fuel cell system of this invention is a fuel cell system which has the solid polymer type fuel cell which laminates the single battery which has two electrodes which *** an electrolyte membrane and this electrolyte membrane. A fueling means to adjust the pressure of this fuel supplied to this fuel cell while supplying gas-like fuel to said fuel cell. A voltage detection means to detect the voltage of each battery module which serves as a humidification means to humidify said fuel supplied to said fuel cell from each single battery or the single battery of the same number which constitutes said fuel cell. An amount change means of fueling to change the amount of supply of said fuel supplied to said fuel cell. Let it be a summary to have a humidification state judging means to judge the humidification state of said electrolyte membrane based on the variation in the voltage of each single battery detected by said voltage detection means before and after changing the amount of supply of fuel by the amount change means of fueling, or each battery module.

[0019] In the 4th fuel cell system of this this invention, [a humidification state judging means] The humidification state of an electrolyte membrane is judged based on the variation in the voltage of each single battery which constitutes the fuel cell detected by a voltage detection means before and after changing the amount of supply of the fuel to a fuel cell by the amount change means of fueling, or each battery module. This judgment is based on the humidification state of that change of the amount of supply of the fuel to a fuel cell affects the humidification state of an electrolyte membrane and an electrolyte membrane appearing as variation in the voltage of each single battery or each battery module.

[0020] Since it judges based on the voltage of each single battery reflecting the humidification state of the amount of supply of the fuel to a fuel cell, and an electrolyte membrane which is the factor which affects the humidification state of an electrolyte membrane, or each battery module according to the 4th fuel cell system of such this invention The humidification state of an electrolyte membrane can be judged more correctly.

[0021] In the 4th fuel cell system of this this invention, [said humidification state judging means] Before the amount of supply of fuel is increased by said amount change means of fueling, [with said voltage detection means] The variation in the voltage of each detected single battery or each battery module [with this amount change means of fueling] When larger than the variation in the voltage of each single battery detected by this voltage detection means, or each battery module after the amount of supply of fuel is increased, it shall be a means to judge with humidification being superfluous

[0022] In the 1st or the 4th fuel cell system of this invention, it shall have a humidification control means to control humidification of said fuel by said humidification means based on the judgment by said humidification state judging means, including each [these] mode. If it carries out like this, the humidification state of an electrolyte membrane can be adjusted based on the

humidification state of an electrolyte membrane.

[0025] In the 1st or the 4th fuel cell system of this invention equipped with this humidification control means, said humidification control means shall be a means to increase the amount of humidification of said fuel by said humidification means, when judged with humidification being insufficient by said humidification state judging means. If it carries out like this, the shortage of humidification of an electrolyte membrane is cancelable.

[0026] Moreover, in the 1st or the 4th fuel cell system of this invention which it has, a humidification control means [said humidification control means] When judged with humidification being insufficient by said humidification state judging means, it shall be a means to increase the pressure of said fuel supplied to said fuel cell by said fueling means. If it carries out like this, since the water vapor pressure in fuel also increases with the increase in the pressure of fuel, the shortage of humidification of an electrolyte membrane is cancelable.

[0027] Furthermore, in the 1st or the 4th fuel cell system of this invention equipped with a humidification control means, have a working temperature control means to control the working temperature of said fuel cell, and [said humidification control means] When judged with humidification being insufficient by said humidification state judging means, it shall be a means to reduce the working temperature of said fuel cell by said working temperature control means. If it carries out like this, since the temperature of fuel will also fall due to the fall of the working temperature of a fuel cell and the water vapor pressure in fuel will become high in connection with this, the shortage of humidification of an electrolyte membrane is cancelable.

[0028] Or in the 1st or the 4th fuel cell system of this invention which it has, a humidification control means [said humidification control means] When judged with humidification being insufficient by said humidification state judging means, it shall be a means to reduce the amount of supply of said fuel to said fuel cell by said fueling means. If it carries out like this, since evaporation of moisture of an electrolyte membrane is controlled with reduction of the amount of supply of fuel, the shortage of humidification of an electrolyte membrane is cancelable.

[0029] In the 1st or the 4th fuel cell system of this invention equipped with a humidification control means, said humidification control means shall be a means to reduce the amount of humidification of said fuel by said humidification means, when judged with humidification being superfluous by said humidification state judging means. If it carries out like this, overhumidification of an electrolyte membrane is cancelable.

[0030] Moreover, in the 1st or the 4th fuel cell system of this invention which it has, a humidification control means [said humidification control means] When judged with humidification being superfluous by said humidification state judging means, it shall be a means to reduce the pressure of said fuel supplied to said fuel cell by said fueling means. If it carries out like this, since the water vapor pressure in fuel also falls with the fall of the pressure

of fuel, overhumidification of an electrolyte membrane is cancelable.

[0029] Furthermore, in the 1st or the 4th fuel cell system of this invention equipped with a humidification control means, have a working temperature control means to control the working temperature of said fuel cell, and [said humidification control means] When judged with humidification being superfluous by said humidification state judging means, it shall be a means to raise the working temperature of said fuel cell by said working temperature control means. If it carries out like this, since the temperature of fuel will also rise by the rise of the working temperature of a fuel cell and the water vapor pressure in fuel will become low in connection with this, overhumidification of an electrolyte membrane is cancelable.

[0030] Or in the 1st or the 4th fuel cell system of this invention which it has, a humidification control means [said humidification control means] When judged with humidification being superfluous by said humidification state judging means, it shall be a means to increase the amount of supply of said fuel to said fuel cell by said fueling means. If it carries out like this, since evaporation of moisture of an electrolyte membrane is promoted with the increase in the amount of supply of fuel, overhumidification of an electrolyte membrane is cancelable.

[0031] In the 1st or the 4th fuel cell system of this invention equipped with humidification control means including each [these] mode In spite of having performed humidification control of said fuel by said humidification control means predetermined time, when it is judged with the shortage of humidification or humidification being superfluous by said humidification state judging means, it shall have a malfunction detection means to detect the malfunction of said fuel cell system. If it carries out like this, the abnormalities of a fuel cell are detectable. In the 1st or the 4th fuel cell system of the invention of this mode, when said malfunction detection means detects abnormalities, it shall have an unusual output means to output these abnormalities. If it carries out like this, the operator can know quickly that abnormalities occurred in the fuel cell. In the 1st or the 4th fuel cell system of the invention equipped with such a malfunction detection means, when said malfunction detection means detects abnormalities, it shall have an operation stop means at the time of the abnormalities which stop operation of said fuel cell system. If it carries out like this, breakage of the fuel cell which may be produced by continuing operation unusually etc. can be prevented.

[0032]

[Mode for carrying out the invention] Next, the form of operation of this invention is explained using a work example. Drawing 1 is the composition figure showing the outline of the composition of the fuel cell system which is one work example of this invention. So that it may illustrate [the fuel cell system 20 of a work example] The fuel gas feed unit 22 which supplies the fuel gas containing hydrogen, and the fuel gas humidifier 23 which humidifies the fuel gas supplied from the fuel gas feed unit 22. The oxidization gas transfer unit 24 which supplies the oxidization gas (for example, air) containing oxygen. The oxidization gas humidifier 25 which

humidifies the oxidization gas supplied from this oxidization gas transfer unit 24. It has the solid polymer type fuel cell 30 generated in response to supply with fuel gas and oxidization gas, the cooling device 50 which cools the fuel cell 30, and the electronic control unit 60 which controls operation of the fuel cell system 20 .

[0033] the fuel gas feed unit 22 being equipment which supplies the fuel gas containing hydrogen. for example, carrying out property modification of the fuel of hydrocarbon systems, such as methanol and methane -- hydrogen -- it is good also as a property modification machine which supplies rich fuel gas, and good also as a fuel gas storage tank which stores the fuel gas containing hydrogen. It is equipment which supplies the oxidization gas containing oxygen, and the oxidization gas transfer unit 24 is good also as an air pump which only supplies air, and good also as an oxidization gas storage tank which stores oxidization gas other than air. In addition, the fuel gas feed unit 22 and the oxidization gas transfer unit 24 are connected to the electronic control unit 60 with the signal line, and the amount of supply of fuel gas and the amount of supply of oxidization gas are controlled by the electronic control unit 60.

[0034] The fuel gas humidifier 23 and the oxidization gas humidifier 25 are humidifiers which are made to evaporate the water pumped up from the water tank 28 , and are supplied to fuel gas or oxidization gas. This fuel gas humidifier 23 and the oxidization gas humidifier 25 are connected to the electronic control unit 60 with the signal line , and the amount of humidification of fuel gas and the amount of humidification of oxidization gas are controlled by the electronic control unit 60.

[0035] The fuel cell 30 is a solid polymer type fuel cell constituted by laminating two or more single batteries 31 . The outline composition of the single battery 31 which constitutes the fuel cell 30 in drawing 2 is shown. The electrolyte membrane 32 which is the membrane of proton conductivity with which the single battery 31 was formed of polymer materials, such as fluororesin, so that it may illustrate, The anode 33 and cathode 34 as a gas diffusion electrode which are formed of the carbon crossing which the catalyst of the alloy which consists of platinum or platinum, and other metal kneaded, and was loaded with it, pinch the electrolyte membrane 32 in respect of the catalyst having kneaded and having been put, and constitute sandwich construction . It is constituted by two separators 35 which make the partition between the single batteries 31 which adjoin while forming the channels 36 and 37 of fuel gas or oxidization gas with an anode 33 and a cathode 34 , inserting this sandwich construction from both sides

[0036] [the fuel cell 30] [the voltage V outputted from the fuel cell 30] [the current I outputted from the voltmeter 40 to detect or the fuel cell 30] The pressure sensor 46 which detects gas pressure P of the ammeter 42 to detect, the fuel cell temperature sensor 44 which detects the temperature of the fuel cell 30, fuel gas, and oxidization gas , the resistance detector 48 which

detects the resistance of the fuel cell 30, etc. are attached. These sensors are connected to the electronic control unit 60 by the signal line. Here, what is calculated as what detects the resistance of the fuel cell 30 from the current value at the time of making a volt alternating current act on the output terminal of the fuel cell 30 is known. Resistance of the fuel cell 30 is divided roughly into the resistance based on resistance of an anode 33, a cathode 34, and a separator 35, and the proton conductivity of the electrolyte membrane 32, judging from the composition of the above-mentioned fuel cell 31. Since the anode 33, the cathode 34, and the separator 35 are formed of a conductive material, they do not change the resistance depending on whether it is humidified or not. On the other hand, proton conductivity changes remarkably by whether the electrolyte membrane 32 is a damp or wet condition. Therefore, the resistance of the fuel cell 30 will reflect the moisturization state of the electrolyte membrane 32.

[0037] The regulation-of-pressure valves 27 and 28 are attached to the exhaust pipe of the fuel gas of the fuel cell 30, and oxidization gas, respectively, and the gas pressure of the fuel gas in the fuel cell 30 or oxidization gas can be adjusted now to it. In addition, the signal line connects with the electronic control unit 60, and each actuators 27a and 28a of the regulation-of-pressure valves 27 and 28 receive the drive control by the electronic control unit 60.

[0038] The cooling-water pipeline 62 which forms a connection-sleeves way with the channel of the cold plate with which fuel cell 30 inside is equipped with the cooling device 50, and the cooling water formed in this cold plate, It has the heat exchanger 58 which is attached to the cooling-water pipeline 62 and cools cooling water by heat exchange with the open air, the pump 54 for cooling water which makes a connection-sleeves way circulate through cooling water, and the circulating-water-temperature sensor 56 which detects the temperature of the cooling water in near the exit of the fuel cell 30 of the cooling-water pipeline 62. The pump 54 for cooling water and the circulating-water-temperature sensor 56 are connected to the electronic control unit 60 by the signal line, and control of cooling of the fuel cell 30 is performed by the electronic control unit 60. That is, the pump 54 for cooling water should drive based on the temperature of the cooling water detected by the circulating-water-temperature sensor 56, and control of the circulation flux of cooling water should do.

[0039] The electronic control unit 60 is constituted considering CPU62 as a one chip microprocessor constituted as a center, and is equipped with RAM66 which remember data temporarily to be ROM64 which memorized the processing program and an input-and-output port (not shown). [this electronic control unit 60] The voltage V outputted from the operational status of the amount of supply and temperature of fuel gas or oxidization gas, and the fuel gas humidifier 23 which are supplied from the fuel gas feed unit 22 and the oxidization gas transfer unit 24 from the flow instrument which is not illustrated, a thermometer, etc., or the oxidization gas transfer unit 24, and the fuel cell 30 from a voltmeter 40 The current I outputted from the

fuel cell 30 from an ammeter 42 The temperature of the fuel cell from the fuel cell temperature sensor 44, gas pressure [of the fuel gas of the fuel cell 30 from the pressure sensor 46 or oxidization gas] P, resistance of the fuel cell 30 from the resistance detector 48, the temperature of the cooling water from the circulating-water-temperature sensor 58, etc. are inputted through the input port. Moreover, from the electronic control unit 60, the drive signal to the fuel gas feed unit 22 or the oxidization gas transfer unit 24, the drive signal to the fuel gas humidifier 23 or the oxidization gas humidifier 25, the drive signal to the pump 54 for cooling water, the lighting signal to the indicator 59, etc. are outputted through the output port.

[0040] Next, operation of the fuel cell system 20 constituted in this way, especially control of humidification of the fuel cell 30 are explained. Drawing 3 is a flow chart which shows an example of the humidification control routine performed by the electronic control unit 60 of the fuel cell system 20 of a work example. This routine is repeatedly performed for every predetermined time until that operation is stopped from from immediately after the fuel cell system 20 starts.

[0041] If this humidification control routine is performed, CPU62 will perform processing which judges the humidification state of the electrolyte membrane 32 first (Step S100). Although carried out by the humidification state judging processing routine illustrated to drawing 4 or drawing 7, detailed explanation of these judgment processings is later mentioned for this judgment processing. In addition, in this judgment processing, "proper humidification", "a shortage of humidification", and "overhumidification" are outputted as a result.

[0042] When the judgment by judgment processing of this humidification state is "proper humidification", counters C1 and C2 are reset (Steps S102-S106). While performing processing which cancels the shortage of humidification of the electrolyte membrane 32 at the time of "a shortage of humidification", a counter C1 is incremented (Step S108, S110). While performing processing which cancels overhumidification of the electrolyte membrane 32 at the time of "overhumidification", a counter C2 is incremented (Step S112, S114).

[0043] [here] as processing which cancels the shortage of humidification of the electrolyte membrane 32 [the circulation flux of cooling water with the processing and the pump 54 for cooling water of the cooling device 50 which fasten the processing and the regulation-of-pressure valves 27 and 28 which increase the amount of humidification of fuel gas or oxidization gas with the fuel gas humidifier 23 or the oxidization gas humidifier 25, and make high gas pressure P of the fuel gas in the fuel cell 30, or oxidization gas] Processing which increases and makes working temperature of the fuel cell 30 low, processing which reduces the amount of supply of the fuel gas supplied to the fuel cell 30 from the fuel gas feed unit 22 or the oxidization gas transfer unit 24 or oxidization gas, etc. are performed. The processing which increases the amount of humidification of fuel gas or oxidization gas among these processings is what cancels the shortage of humidification of the electrolyte membrane 32

directly by increasing the amount of humidification of fuel gas or oxidization gas. The processing which makes high gas pressure P of fuel gas or oxidization gas is what cancels the shortage of humidification of the electrolyte membrane 32 based on the water vapor pressure in fuel gas or oxidization gas increasing with the increase in gas pressure. The temperature of fuel gas or oxidization gas also falls [the processing which makes working temperature of the fuel cell 30 low] due to the fall of the working temperature of the fuel cell 30. It is what cancels the shortage of humidification of the electrolyte membrane 32 based on the water vapor pressure in fuel gas or oxidization gas becoming high in connection with this. The processing which reduces the amount of supply of fuel gas or oxidization gas cancels the shortage of humidification of the electrolyte membrane 32 based on evaporation of moisture of the electrolyte membrane 32 being controlled with reduction of the amount of supply of fuel gas or oxidization gas. Thus, although the processing which cancels the shortage of humidification of the electrolyte membrane 32 has more than one, it is good also as what performs one of these processings, and good also as what is performed combining plurality. Moreover, it is good also as what replaces one or more of these processings with one by one, and performs them whenever a humidification control routine is performed.

[0044] moreover, as processing which cancels overhumidification of the electrolyte membrane 32 [the circulation flux of cooling water with the processing and the pump 54 for cooling water of the cooling device 50 which open the processing and the regulation-of-pressure valves 27 and 28 which reduce the amount of humidification of fuel gas or oxidization gas with the fuel gas humidifier 23 or the oxidization gas humidifier 25, and make low gas pressure P of the fuel gas in the fuel cell 30, or oxidization gas] Processing which reduces and makes working temperature of the fuel cell 30 high, processing which increases the amount of supply of the fuel gas supplied to the fuel cell 30 or oxidization gas from the fuel gas feed unit 22 or the oxidization gas transfer unit 24, etc. are performed. The processing which reduces the amount of humidification of fuel gas or oxidization gas among these processings is what cancels overhumidification of the electrolyte membrane 32 directly by reducing the amount of humidification of fuel gas or oxidization gas. The processing which makes low gas pressure P of fuel gas or oxidization gas is what cancels overhumidification of the electrolyte membrane 32 based on the water vapor pressure in fuel gas or oxidization gas falling with the fall of gas pressure. As for the processing made high, the temperature of fuel gas or oxidization gas also goes up the working temperature of the fuel cell 30 by the rise of the working temperature of the fuel cell 32. It is what cancels the shortage of humidification of the electrolyte membrane 32 based on the water vapor pressure in fuel gas or oxidization gas becoming low in connection with this. The processing which increases the amount of supply of fuel gas or oxidization gas cancels overhumidification of the electrolyte membrane 32 based on evaporation of moisture of the electrolyte membrane 32 being promoted with the increase in

the amount of supply of fuel gas or oxidation gas. Thus, the processing which cancels overhumidification of the electrolyte membrane 32 has more than one, and it is good also as what performs one of these processings, and good also as what is performed combining plurality. Moreover, it is good also as what replaces one or more of these processings with one by one, and performs them whenever a humidification control routine is performed.

[0045] A counter C1 is incremented, when the processing which cancels the shortage of humidification of the electrolyte membrane 32 when the humidification control routine of drawing 5 is performed repeatedly is continued and is performed, and it counts the number of times of continuous processing of the processing which cancels the shortage of humidification. A counter C2 counts the number of times of continuous processing of the processing which cancels overhumidification of the electrolyte membrane 32.

[0046] Thus, if processing which cancels the shortage of humidification and overhumidification based on the judgment result of a humidification state of the electrolyte membrane 32 is performed, as for CPU62, either of counter C1 and C2 will judge whether it has become more than the threshold Cref (Step S118). A threshold Cref is set up based on the time required although it can judge that the processing for canceling the shortage of humidification of the electrolyte membrane 32 and overhumidification carried out enough, or the number of times of processing. therefore, when either of counter C1 and C2 is more than the threshold Cref It judges that abnormalities have occurred in the fuel cell system 20, in order to tell an operator about abnormalities, an indicator 68 is turned on (Step S119), operation of the fuel cell system 20 is stopped for protection, such as the fuel cell 30, (Step S120), and this routine is ended. in addition, any of counter C1 and C2 -- although -- when it is under the threshold Cref, this routine is ended noting that it cannot judge with abnormalities having still occurred in the fuel cell system 20.

[0047] As explained above, according to the fuel cell system 20 of a work example, based on the judgment result of a humidification state of the electrolyte membrane 32, the humidification state of the electrolyte membrane 32 is controllable by performing the humidification control routine of drawing 5. For example, the shortage of humidification of the electrolyte membrane 32 and overhumidification are cancelable by fluctuating the amount of humidification of the fuel gas humidifier 23 or the oxidization gas humidifier 25. Moreover, the regulator-of-pressure valves 27 and 29 are fastened, or are opened, gas pressure P of the fuel gas in the fuel cell 30 or oxidization gas can be made high, or it is made low, the water vapor pressure in fuel gas or oxidization gas is fluctuated, and the shortage of humidification of the electrolyte membrane 32 and overhumidification can be canceled. Furthermore, it is made high, and, it can be made the circulation flow of cooling water with the pump 54 for cooling water of the cooling device 50 is fluctuated, and water vapor pressure in fuel gas or oxidization gas can be made high, or low, and the shortage of humidification of the electrolyte membrane 32 and

overhumidification can be canceled. [making working temperature of the fuel cell 30 low] Or the amount of supply of the fuel gas supplied to the fuel cell 30 from the fuel gas feed unit 22 or the oxidization gas transfer unit 24 or oxidization gas can be fluctuated, evaporation of moisture of the electrolyte membrane 32 can be promoted or controlled, and the shortage of humidification of the electrolyte membrane 32 and overhumidification can be canceled.

[0048] Moreover, by performing the humidification control routine of drawing 2 according to the fuel cell system 20 of a work example in spite of having performed processing which cancels the shortage of humidification of the repetition electrolyte membrane 32, and overhumidification, when neither the shortage of humidification of the electrolyte membrane 32 nor overhumidification is canceled it judges with abnormalities having occurred in the fuel cell system 20, and while telling an operator, operation of the fuel cell system 20 can be stopped. As a result, the operator can know abnormalities quickly and can prevent breakage of the fuel cell system 20 which may be produced by operating the fuel cell system 20 where abnormalities are caused etc.

[0049] Next, processing of Step S100 of drawing 2, i.e., the processing which judges the humidification state of the electrolyte membrane 32, is explained. Each of drawing 4 or drawing 7 are flow charts which show an example of the humidification state judging processing routine which judges the humidification state of the electrolyte membrane 32. It is good also as what performs any humidification state judging processing 1 of these four humidification state judging processing routines at Step S100 of drawing 2, and good also as what is performed combining two or more humidification state judging processing routines. Moreover, it is good also as what replaces one or more of each of these processing routines with one by one, and performs them whenever the humidification control routine of drawing 2 is performed. Each humidification state judging processing routine is explained hereafter.

[0050] If the humidification state judging processing routine of drawing 4 is performed, CPU52 will perform processing which reads the output current I of the fuel cell 30 first detected by an ammeter 42, and the resistance R of the fuel cell 30 detected by the resistance detector 48 (Step S200). And when Current I is not in agreement with predetermined current Iset as compared with Current I and the predetermined current Iset which were read (Step S202), it returns to the processing which reads the current I of Step S200, and Resistance R. Here, predetermined current Iset is set up as general current which is not greatly as current outputted from the fuel cell 30, and is not small. Therefore, the current I outputted from the fuel cell 30 is frequently in agreement with predetermined current Iset.

[0051] If Current I is in agreement with predetermined current Iset, Resistance R will be substituted for resistance R0 last time (Step S204), and processing which reads the resistance R of the fuel cell 30 again detected by the resistance detector 48 is performed (Step S206). And differentiation value dR/dt is computed by breaking what subtracted resistance R0 from

the read resistance R last time by minute time deltat (Step S208). Minute time deltat is what is set up as time measured by reading of the resistance R of Step S208 from reading of the resistance R of the step S209 in case Current I is in agreement with predetermined current load here. It is set by the grade in which a parallel processing is carried out by performance [of CPU62 of the electronic control unit 60], and CPU62. In addition, since difference value dR/dt is change of the resistance R of the fuel cell 30 in minute time deltat, it cannot be strictly called differentiation value, but since it acts on an idea easily, it carries out becoming a value near a strict differentiation value in calling it a differentiation value by this example.

[0062] If differentiation value dR/dt is calculated, calculated differentiation value dR/dt will judge whether it is in the proper humidification range set up with a threshold alpha and a threshold beta (Step S210). Since the proton conductivity becomes low and the reaction to tiny differences of a humidification state of the electrolyte membrane 32 becomes blunt when humidification of the electrolyte membrane 32 is insufficient, differentiation value dR/dt serves as a small value. On the other hand, since the proton conductivity becomes high and the reaction to few differences of a humidification state of the electrolyte membrane 32 also becomes quick when humidification of the electrolyte membrane 32 is superfluous, differentiation value dR/dt serves as a big value. Therefore, differentiation value dR/dt in case the humidification state of the electrolyte membrane 32 is in the proper range is calculated. While making that minimum into a threshold alpha, the humidification state of the electrolyte membrane 32 can be judged by carrying out proper humidification definition of that maximum as a threshold beta, and comparing computed differentiation value dR/dt with this range.

[0063] "Proper humidification" is made into a judgment result when computed differentiation value dR/dt is in the proper humidification range (Step S212). When differentiation value dR/dt is below the threshold alpha, "a shortage of humidification" is made into a judgment result (Step S214), and when differentiation value dR/dt is more than the threshold beta, the routine is ended by making "overhumidification" into a judgment result (Step S216).

[0064] According to the fuel cell system 20 of a work example which performs the humidification state judging processing routine of drawing 4 explained above, the humidification state of the electrolyte membrane 32 can be judged based on the resistance R of the Current I and the fuel cell 30 which are outputted from the fuel cell 30. And since the resistance R of the fuel cell 30 reflects the humidification state of the electrolyte membrane 32 directly, it can judge the humidification state of the electrolyte membrane 32 more correctly.

[0065] Next, the humidification state judging processing routine illustrated to drawing 5 is explained. When this routine is performed, [CPU62] Processing which increases the amount of supply of the oxidation gas first supplied to the fuel cell 30 by the oxidization gas transfer unit 24 is performed (Step S300). Though the current I outputted from the fuel cell 30 detected by

an ammeter 42 is in agreement with predetermined current test Current I, the processing which reads the voltage V outputted from the fuel cell 30 detected by a voltmeter 40, and processing of [current / I / which was read / predetermined current test] are repeated (Step S301, S302). Here, predetermined current test is the same as that of the predetermined current test in the humidification state judging processing routine of drawing 4.

[0056] If Current I is in agreement with predetermined current test, voltage V will be substituted for voltage V0 last time (Step S304), and processing which reads the voltage V of the fuel cell 30 again detected by a voltmeter 40 is performed (Step S306). And differentiation value dV/dt is computed by breaking what substituted voltage V0 from the read voltage V last time by minute time delta t (Step S308). Minute time delta t: what is set up as time required by reading of the voltage V of Step S306 from reading of the voltage V of the Step S301 in case Current I is in agreement with predetermined current test here, it is the same as that of minute time delta t in the humidification state judging processing routine of drawing 4 to be set by the grade in which a parallel processing is carried out by performance I of CPU62 of the electronic control unit 60] and CPU62. In addition, although there is also a point which lacks strict nature like [dV/dt / differentiation value] differentiation value dV/dt, it will be similarly called a differentiation value.

[0057] If differentiation value dV/dt is calculated, calculated differentiation value dV/dt will judge whether it is in the proper humidification range set up with a threshold gamma and a threshold delta (Step S310). Since change seldom arises in proton conductivity even if humidifying becomes still more insufficient when humidification of the electrolyte membrane 32 is insufficient since evaporation of moisture of the electrolyte membrane 32 is promoted by increasing the amount of supply of oxidization gas, differentiation value dV/dt serves as a small value. On the other hand, since evaporation of moisture of the electrolyte membrane 32 is promoted by the increase in the amount of supply of oxidization gas and it becomes close to proper humidification when humidification of the electrolyte membrane 32 is sufficient, change of proton conductivity also becomes large and differentiation value dV/dt also serves as a big value. Therefore, differentiation value dV/dt in case the humidification state of the electrolyte membrane 32 is in the proper range is calculated, While making that minimum into a threshold gamma, the humidification state of the electrolyte membrane 32 can be judged by carrying out proper humidification definition of that maximum as a threshold delta, and comparing computed differentiation value dV/dt with this range.

[0058] "Proper humidification" is made into a judgment result when computed differentiation value dV/dt is in the proper humidification range (Step S312). When differentiation value dV/dt is below the threshold gamma, "a shortage of humidification" is made into a judgment result (Step S314), and when differentiation value dV/dt is more than the threshold delta, this routine is ended by making "overhumidification" into a judgment result (Step S316).

[0058] [according to the fuel cell system 20 of a work example which performs the humidification state judging processing routine of drawing 5 explained above] The humidification state of the electrolyte membrane 32 can be judged based on the current I outputted from the fuel cell 30 when increasing the amount of supply to the fuel cell 30 of oxidization gas, and the voltage V outputted from the fuel cell 30.

[0059] By the humidification state processing judging routine of this drawing 5 , although only the amount of supply to the fuel cell 30 of oxidization gas was increased, it is good also as what increases the amount of supply to the fuel cell 30 of fuel gas with the increase in the amount of supply to the fuel cell 30 of the oxidization gas.

[0060] Next, the humidification state judging processing routine illustrated to drawing 6 is explained. If this routine is performed, CPU82 will read the voltage V outputted from the fuel cell 30 first detected by a voltmeter 40 (Step S400), and will substitute the read voltage V for voltage V0 last time (Step S402). And the amount of supply to the fuel cell 30 of oxidization gas is increased (Step S404), and processing which reads the voltage V of the fuel cell 30 again detected by a voltmeter 40 is performed (Step S406). And voltage deviation deltaV is computed by subtracting voltage V0 from the read voltage V last time (Step S408).

[0062] If voltage deviation deltaV is computed, it will be investigated whether the value of this voltage deviation deltaV is a negative value (Step S410). When voltage deviation deltaV is zero or more values, "proper humidification" is made into a judgment result (Step S412), and when voltage deviation deltaV is a negative value, this routine is ended by making "a shortage of humidification" into a judgment result (Step S414). [this judgment] although evaporation of moisture of the electrolyte membrane 32 is promoted by increasing the amount of supply to the fuel cell 30 of oxidization gas When the electrolyte membrane 32 is in proper humidification, even if evaporation of a certain amount of moisture is promoted, it is based on the voltage V which change is not seen, but it becomes still more insufficient when humidification of the electrolyte membrane 32 is insufficient humidifying it, and is outputted to the voltage V outputted from the fuel cell 30 from the fuel cell 30 becoming small.

[0063] According to the fuel cell system 20 of a work example which performs the humidification state judging processing routine of drawing 6 explained above, the humidification state of the electrolyte membrane 32 can be judged based on the voltage V outputted from the fuel cell 30 when increasing the amount of supply to the fuel cell 30 of oxidization gas.

[0064] By the humidification state processing judging routine of this drawing 6 , although only the amount of supply to the fuel cell 30 of oxidization gas was increased, it is good also as what increases the amount of supply to the fuel cell 30 of fuel gas with the increase in the amount of supply to the fuel cell 30 of the oxidization gas.

[0065] Next, the humidification state judging processing routine illustrated to drawing 7 is

explained. In the fuel cell system 20 which performs this humidification state judging processing routine, the voltmeter 40 attached to the fuel cell 30 needs to be what can detect the voltage of each single battery 31 which constitutes the fuel cell 30. A voltmeter 40 is hereafter explained as what detects the voltage V of each single battery 31 of the fuel cell 30.
[0066] If the humidification state judging processing routine of this drawing 7 is performed, CPU52 will read the voltage V of each single battery 31 which constitutes the fuel cell 30 first detected by a voltmeter 40 (Step S500), and will calculate distributed sigma0 of each read voltage V (Step S502). Then, the amount of supply to the fuel cell 30 of oxidization gas is increased (Step S504), the voltage V of each single battery 31 again detected by a voltmeter 40 is read (Step S506), and distributed sigma1 of each read voltage V is calculated (Step S508).
[0067] And the calculated distributions sigma0 and sigma1 are compared (Step S510). When distributed sigma0 is less than distributed sigma1, "proper humidification" is made into a judgment result (Step S512), and when distributed sigma0 is larger than distributed sigma1, this routine is ended by making "overhumidification" into a judgment result (Step S514). By increasing the amount of supply to the fuel cell 30 of oxidization gas, by promoting evaporation of moisture of the electrolyte membrane 32, the electrolyte membrane 32 in the state where humidification is superfluous approaches a proper humidification state, and this judgment is based on the variation in the voltage V of each single battery 31 becoming small.
[0068] According to the fuel cell system 20 of a work example which performs the humidification state judging processing routine of drawing 7 explained above, the humidification state of the electrolyte membrane 32 can be judged based on the variation in the voltage V of each single battery 31 which constitutes the fuel cell 30 before and after increasing the amount of supply to the fuel cell 30 of oxidization gas.
[0069] Although the humidification state of the electrolyte membrane 32 was judged by the humidification state processing judging routine of this drawing 7 from the variation in the voltage V of each single battery 31 which constitutes the fuel cell 30 (distribution), it is good also as what constitutes the fuel cell system 20 by two or more battery modules which consist of two or more single batteries 31, and judges the humidification state of the electrolyte membrane 32 based on the variation in the voltage of each battery module (distribution). Moreover, by the humidification state processing judging routine of drawing 7, although only the amount of supply to the fuel cell 30 of oxidization gas was increased, it is good also as what increases the amount of supply to the fuel cell 30 of fuel gas with the increase in the amount of supply to the fuel cell 30 of this oxidization gas.
[0070] As mentioned above, although the form of operation of this invention was explained using the work example, as for this invention, it is needless to say that it can carry out with the form which becomes various within limits which are not limited to such a work example at all.

and do not deviate from the summary of the invention.

[Translation done.]